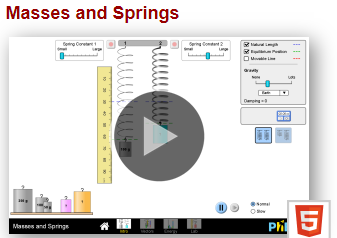
**Masses and Springs**

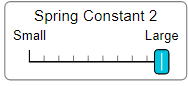
<https://phet.colorado.edu/en/simulation/mass-spring-lab>

****NAME DATE

Google “PHET and SPRING”

SELECT INTRO

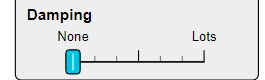
1.Put a 100 g mass on the first and the second springs. They should hang at the same level and move similarly. **Always carefully place the mass on the spring, NEVER PUSH UP OR STRETCH**

* Remove the mass from spring 2
* Increase the **SPRING CONSTANT 2** (make large, aka make the spring stiffer)
* Put the 100 g mass back on the second spring

2. What happens when the stiffness (constant) of spring 2 is increased?

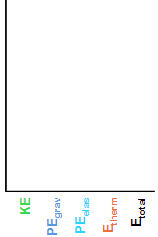
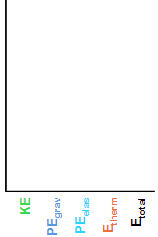
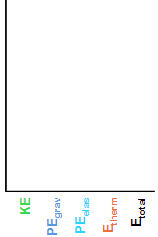
3. Remove the second mass, make the value small for Spring Constant 2, and place the mass back on. What happens when the stiffness (constant) is decreased?

ON THE BOTTOM, SELECT ENERGY:



SET DAMPING to NONE

1. Draw the ENERGY BAR GRAPH diagrams when the mass is at the identified positions



Energies at LOWEST point (full stretch)

Energies at MID point

Energies at HIGHEST point (no stretch)

1. When you put the 100 g mass on the spring, describe what happens to the
   1. KE as the spring bounces:
   2. PEgrav as the spring bounces:
   3. PEelas as the spring bounces:
   4. Etotal as the spring bounces:

*\*Note we are ignoring Etherm for now*

1. Remove the mass, make the **SPRING CONSTANT 1** Small and place the mass back on.
   1. What changes about the springs motion?
   2. What changes about the springs energy bars?
2. Remove the mass, make the **SPRING CONSTANT 1** Large and place the mass back on.
   1. What changes about the springs motion?
   2. What changes about the springs energy bars?

* RESET 
* Set Damping (friction) to Zero.
* Add the 100 g mass to the Spring, it should bounce or osculate up and down.
* Slow down the time

5.Where does the spring have maximum gravitational potential energy?

6. Where is the gravitational potential energy the least?

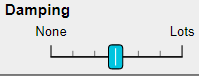
7. Where is the kinetic energy zero (*may be MORE than one point*)?

8. Where is the kinetic energy the highest (at its maximum)?

9. Where is the elastic potential energy zero?

10. Where is the spring when elastic potential energy is at its maximum?

11. While bouncing does the total energy ever change?

12. SET Friction (**Damping)** to the middle and return time to NORMAL:

a. What changes about the springs motion when Friction is on?

b. What changes about the energy bars when Friction (damping) is on?

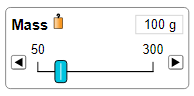


SELECT LAB:

-PUT THE RULLER SO ZERO is lined up with the bottom of the spring.

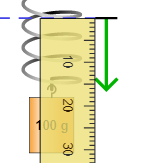
-DAMPING to LOTS

-SELECT DISPLACEMENT NATURAL LENGTH

-To CHANGE MASS use the sliding bar at the top. Change the mass prior to placing the mass on the spring.

-You may choose to solve for the spring constant using two methods offered below.

**-** Place the mass on the end of spring being careful not to also push up or down when ready to start

-*To measure, use ruler to measure from the zero on ruler to the bottom of the spring (not the mass)*

* OPTION 1: Select a mass value *(convert to kg!)* and calculate the Force of Gravity. Hang the mass carefully and measure displacement *(convert to meters!).* Hooke’s Law models this relationship and can be viewed as **F=kΔx**. Solve for Spring constant (**k**) and repeat this process with new masses. DO 5 times minimum and average your k values, they should end up in units of N/m. For today use magnitudes only and ignore the negatives of direction.
* OPTION 2: Select a mass value *(convert to kg!)*, calculate gravity. Hang mass carefully and measure displacement *(convert to meters!).* For this lab we will then graph your displacement (**Δx**) on the x-axis and Force (**F**) on the y-axis. Repeat for a minimum of 5 different masses. The slope of your graph will be the spring constant (**k**). Graph by hand with a line of best fit or via a computer graphing program. You may assume 0 m occur when the force of 0 N is present and may use 0,0 as a data point. Remember in physics you cannot assume 0,0 is a data point on a graph by default; it must represent real data.

*WORK SPACE*

Spring Constant (**k**) =

**SOLVING FOR UNKNOWN**:

Using the spring constant (**k**) you found above you will need to find the mass of the mystery masses in both kilograms as well as grams and then do a verification of your answer.

* Carefully place the mystery mass on the spring and measure the displacement (Δx)
* Using the spring constant (**k**) and displacement find the Force using Hooke’s Law

**F = kΔx**

* Today we will ignore any negatives and directions, so only use magnitudes
* Knowing the Force causing the displacement is the force of gravity (weight), determine the mass in kg.
* On the back page, show work, record answers and then repeat for the other unknown mass.
* When you have found the mass in grams, verify your answer by sliding the mass bar to your calculated value and measure the displacement, if it is approximately the same displacement you have successfully validated your work. If the displacement is sizably different, go back and correct your work or experimental methodology.

SHOW WORK

**RED MYSTERY (?) MASS**

Δx =

F =

Mass in kg =

Mass in grams =

Measure of known mass (set to the above value) for displacement Δx =

Is your measure within 1 cm (0.01 m) of the displacement of the mystery mass?

*Note most common mistake is PUSHING UP or PULLING down with either your mystery mass or the known mass, redo the measurement carefully, if it is still off then repeat the lab. Space below if you need to redo this portion of the lab.*

**BLUE MYSTERY (?) MASS**

Δx =

F =

Mass in kg =

Mass in grams =

Measure of known mass (set to the above value) for displacement Δx =

Is your measure within 1 cm (0.01 m) of the displacement of the mystery mass?

*Note most common mistake is PUSHING UP or PULLING down with either your mystery mass or the known mass, redo the measurement carefully, if it is still off then repeat the lab. Space below if you need to redo this portion of the lab.*